IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Robert Cochran and Jeffrey D. Ferreira-Pro		
Assignee:	Hewlett-Packard Development Company L.P.		
Title:	HIERARCHICAL STORAGE SYSTEM		
Serial No.:	10/697,821	Filing Date:	October 29, 2003
Examiner:	Vy, Hung T	Group Art Unit:	9535
Docket No.:	200311026-1	Confirmation No.:	9535

Irvine, California
September 18, 2006

COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 CFR 1.131

We are applicants of the above-identified patent application and co-inventors of the subject matter described and claimed therein.

We were employed by Hewlett Packard Company, assignee of the above-identified patent application, at conception of the subject matter.

We believe we are original, first and joint inventors of subject matter (process, machine, manufacture, or composition of matter, or an improvement thereof) which is claimed and for which a patent is sought by way of the above-identified application..

Reference Matsunami et al. (U.S. Publication No. 2004/0193760), has been cited by the Examiner in rejecting Applicants' Claims 1-25 under 35 U.S.C. §102(e). The international filing date of Matsunami et al. is March 27, 2003. As described herein, the subject matter set forth in Claims 1-25 of the application was conceived in the United States

prior to March 27, 2003, and the applicants proceeded with due diligence from prior to the reference date to the filing of the application.

Prior to March 27, 2003, we conceived of the subject matter that is claimed in the above-identified patent application. Also prior to March 27, 2003 we filed an invention disclosure with Hewlett-Packard Company, assignee of the above-identified application. The application was prepared and filed in due course on October 29, 2003.

Attached hereto as exhibit I are five pages that comprise a copy of an official Invention Disclosure form that is used according to official Hewlett Packard procedures. Versions of Invention Disclosure were prepared and submitted on March 8, 2003 and March 11, 2003. The first two pages of the Invention Disclosure include reference material, title, inventors, and inventor contact information. Third and fifth pages describe technical aspects of an embodiment showing the claimed structure and techniques including the storage system comprising a storage array containing a plurality of storage devices of at least three types (including Fibre Channel (FC) and Serial ATA (S-ATA) and having a respective class hierarchy. The disclosure also shows a controller coupled to the storage device hierarchy and capable of executing an hierarchical storage management capability that selectively controls access to the hierarchy of storage devices corresponding to claims 1, 10, 18, and 25. Also shown are specifics of the priority of the hierarchy, as claimed in independent claims.

We declare that all acts in conception of the invention occurred in the United States.

We declare that all statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and all statements made herein are made with the knowledge that whoever, in any matter within the jurisdiction of the Patent and Trademark Office, knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be subject to the penalties including fine or imprisonment or both as set forth under 18 U.S.C. 1001, and that violations of this paragraph may jeopardize the validity of the application or this document, or

the validity or enforceability of any patent, trademark registration, or certificate resulting therefrom.

Full name of joint inventor: Robert Cochran
Inventor's Signature: _____ Date: 8/15-06
Residence: Roseville, CA
Post Office Address: 3320 Markham Way, Roseville, CA 95747 Citizenship: U.S.A.

Full name of joint inventor: Jeffrey D. Ferreira-Pro
Inventor's Signature: _____ Date: _____
Residence: Folsom, CA
Post Office Address: [illegible] St., Folsom, CA 95630 Citizenship: U.S.A.

the validity or enforceability of any patent, trademark registration, or certificate resulting therefrom.

Full name of joint inventor:	Robert Cochran		
Inventor's Signature:	_____	Date:	_____
Residence:	Roseville, CA		
Post Office Address:	3256 Markham Way Roseville, CA 95747	Citizenship:	U.S.A.
Full name of joint inventor:	Jeffrey M. Ferreira-Prof		
Inventor's Signature:	_____	Date:	9-15-06
Residence:	Folsom, CA		
Post Office Address:	808 Figueroa St. Folsom, CA 95630	Citizenship:	U.S.A.

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DECLARATION UNDER 37 CFR 1.131

I am patent attorney who prepared and filed the above-identified patent application.

"Reasonable diligence is all that is required of the attorney. Reasonable diligence is established if attorney worked reasonably hard on the application during the continuous critical period. If the attorney has a reasonable backlog of unrelated cases which he takes up in chronological order and carries out expeditiously, that is sufficient". Manual of Patent Examining Procedure (MPEP) §2138.06.

Hewlett-Packard Company has an extensive patent program, having tens of thousands of patents globally. Patent procedures include review and analysis of a large number of patent disclosures, leading to assignment of selected disclosures for patent preparation. Hewlett-Packard Company exercised reasonable diligence in review and analysis of the disclosures from submission of the disclosure on about March 11, 2003, to distribution of the disclosure assignment of June 30, 2003. The review and handling time from March 11, 2003,

to June 30, 2003, is believed to be reasonable and normal for a technology company of the size and technical complexity of Hewlett-Packard Company.

On June 30, 2003, I received a disclosure document and request for quote from Hewlett-Packard Company, assignee of the above-identified patent application. I diligently prepared the application and filed on October 30, 2003, including interaction with inventors, preparation of the patent draft, preparation of drawings, and review by in-house corporate counsel. The disclosure document was received by Hewlett-Packard Company on March 17, 2003 showing diligence from a time just prior to the reference date of March 27, 2003, to filing.

I have attached copies documents that establish invention conception prior to the reference date and diligence from a time prior to the reference date and filing. Evidentiary documents include:

Exhibit I is a copy of the disclosure document received by Hewlett-Packard Company on March 8, 2003, with supplemental addendum on March 8, 2003. Other dates that establish earlier conception are blocked off. The first two pages of the Invention Disclosure include reference material, title, inventors, and inventor contact information. Third and fifth pages describe technical aspects of an embodiment showing the claimed structure and techniques including the storage system comprising a storage array containing a plurality of storage devices of at least three types (including Fibre Channel (FC) and Serial ATA (S-ATA) and having a respective class hierarchy. The disclosure also shows a controller coupled to the storage device hierarchy and capable of executing an hierarchical storage management capability that selectively controls access to the hierarchy of storage devices corresponding to claims 1, 10, 18, and 25. Also shown are specifics of the priority of the hierarchy, as claimed in independent claims.

Exhibit II are nine pages of an official document for usage in Hewlett-Packard's Disclose 4.5 – HP Invention Disclosure System. The document includes invention disclosure material on the first two pages, inventor information and other administrative information on third and fourth pages, some of which is blacked out for privacy purposes, and the final five pages are disclosure material that duplicates appendix I. The disclosure material shows

submission on March 11, 2003, showing invention prior to the date of the reference cited by the Examiner. The fourth page shows that the disclosure was received by the Hewlett-Packard legal department on March 17, 2003.

Exhibit III is an email dated June 30, 2003. In combination, exhibits II and III show diligence in review of the disclosure and determining whether to proceed on the application in the time from submission of the disclosure on March 11, 2003, to emailing the disclosure to outside counsel on June 30, 2003. The filing date of October 29, 2003 indicates diligence in working with inventors to prepare the application, and review by corporate counsel.

I declare that all statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and all statements made herein are made with the knowledge that whoever, in any matter within the jurisdiction of the Patent and Trademark Office, knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be subject to the penalties including fine or imprisonment or both as set forth under 18 U.S.C. 1001, and that violations of this paragraph may jeopardize the validity of the application or this document, or the validity or enforceability of any patent, trademark registration, or certificate resulting therefrom.

Full name of attorney:	Ken J. Koestner		
Attorney's Signature:	_____	Date:	_____
Residence:	Newport Beach, California		
Post Office Address:	18662 MacArthur Blvd, Ste. 400 Irvine, CA 92612	Citizenship:	U.S.A.

Exhibit I

AHRS - ERS

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Rev. 1

External Reference Specification for:
AHRS – Array-based Hierarchal Rotational Storage

[To Accompany the Patent Disclosure by the same name. Intended to supply sufficient data that someone skilled in the art could use the ERS to implement a working model.]

Thumbnail Sketch: Traditional disk arrays have only 2 levels of hierarchical storage: (1) volatile solid state cache/shared-memory, and (2) non-volatile high-performance, high-priced (3-6 centsMB) SCSI/FC disks (rotational storage)

This patent describes a disk array containing, alongside hierarchy, there is a hierarchically different level of low-cost (~1.0 - 1.5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for nearline (but not offline) storage and/or for HSM-type low usage user data storage.

SATA drives external to the array are not new (not are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array with the drives are empowered to offer some SATA storage for low access discovery duties in FW-based HSM, and to retain some for critical short term and unpredictable storage needs that are not appropriate for cache/shared-memory or high price/performance storage (or for which there is no pre-allocated space). This concept is ideal to be used with several prior patent submissions:

- SBLMR - Safety Stamp LUN Mirror Resync[docket # 10011270]
- PLMVS - Primary Local Mirror Virtual Shadow [docket # 10030150]
- SLM - Snapshot Locality Migration [not yet submitted]
- BWOP - Backup Window Overdraft Protection [not yet submitted]

In which extra storage space (without the constraints of LUN copy licenses, pre-assignment or like configuration) is unexpectedly and temporarily needed within a disk array (as opposed to having to consider the uncontemplated use of hot spare disks). Specifically, the patent entitled "Backup Window Overdraft Protection (BWOP)" in which a customer (that does not have licensed LUN copy or snapshot functionality or does not currently have it set up for Zero Downtime Backup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the endangered backup using temporary non-volatile storage of sufficient capacity. The AHRS concept would be a significant competitive differentiator and potential lock-out sale.

Bob Cochran – HP Roseville, CA. NSS R&D Engineer/Scientist. (Opus 43)
Jeff Ferreira-Pro – HP Roseville

HP Confidential

HP-NSS R&D (Network Storage Solutions)

Revision History

Rev.1 1-08-03, 1-11-03

High-Level Introduction

Traditional disk arrays have only 2 levels of hierarchical storage:

(1) solid state cache/shared-memory, and
(2) high-performance, high-priced (3-5 cents/MB) SCSI/FC disks (rotational storage).

This patent describes a disk array rotational storage hierarchy. That is, a hierarchically inferior level of low-price (~ 1/3 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for temporary/unexpected (but critical) storage and/or for HSM-type low usage user data storage.

SATA drives external to the array are not new (nor are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array, with the firmware empowered to offer some SATA storage for low access customer data (as in FW-based HSM) and to retain some for critical short term and unpredictable storage needs that are not appropriate for volatile cache/shared-memory or high price/performance non-volatile storage (or for which there is no pre-allocated space).

This concept is ideal to be used with several prior patent submissions in which extra storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array (as opposed to having to consider the unconventional use of hot spare disks). Specifically, the patent entitled "Backup Window Overdraft Protection" (BWOP) in which a customer (that does not have licensed LUN copy or snapshot functionality, or does not currently have it set up for Zero Downtime Backup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the endangered backup using temporary non-volatile storage of sufficient capacity.

The AHRS concept would be a significant competitive differentiator and potential lock-out spec. Customers attracted to this feature would be in the mid and high-end range. This feature could result in solution configurations involving significant product/services drag to several parts of HP.

NOTE: If this concept were an enabler for just a single related patent, I would have been tempted to combine the two. However, the fact that it equally enables at least 4 other patents, suggests that it should not become entangled/identified with any one of them.

What's Not New – (Prior Art)

- FC Disk arrays
- SATA Disk Drives
- Host SW controlled HSM (via external components)
- Intra-array LUN replication (e.g. snapshots and full copies)
- Inter-array LUN replication
- AutoRAID, disk array FW which moves data between RAID-1 and RAID-5 disk groups, depending on usage patterns (still all high-cost FC disks)
- Auto-LUN, host SW which moves files between RAID-1 and RAID-5 disk groups (and 10k rpm and 15k rpm), depending on usage patterns (still all high-cost FC disks)

What "is" new - The Proposed Improvements

Firmware-based Hierarchical Storage Management (HSM) within a disk array utilizing both FC and SATA disk drives would be new. In this context, array FW could save the SATA storage as uncommitted/unstructured and only use it for:

- Low Usage files (tolerant of lower performance)
- Temporary (but critical), uncommitted, non-volatile storage that may or may not be pre-allocated into specific LUNs:
  - SBLMR - Safer Bitmap LUN Mirror Resync[10011270]
  - PLMVS - Primary Local Mirror Volume Shadow [100201390]
  - SLM - Snapshot Liability Mitigation (not yet submitted)
  - BWOP – Backup Window Overdraft Protection (not yet submitted)
  - etc.
- Intra-array LUN snapshots
- Intra-array full LUN copies
- Inter-array LUN copies

This concept is ideal to be used with several prior patent submissions:

- SBLMR - Safer Bitmap LUN Mirror Resync[docket #10011270]
- PLMVS - Primary Local Mirror Volume Shadow [docket #100201390]
- SLM - Snapshot Liability Mitigation (not yet submitted)
- BWOP – Backup Window Overdraft Protection (not yet submitted)
- etc.

in which extra storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array.

HP-NSS R&D (Network Storage Solutions)

EXHIBIT II

Invent

Disclosure No. 200311026

Invention Disclosure - DBI Document No. 6GSP

PD No.	Date Received	Collection
200311026	3/17/03	ESGMSS

General Information

Title AHRS - Array-based Hierarchal Rotational Storage

Abstract Traditional disk arrays have only 2 levels of hierarchical storage: (1) volatile solid state cache/shared-memory, and (2) non-volatile high-performance, high-priced (3-6 cents/MB) SCSI/FC disks (rotational storage).

This patent describes a disk array rotational storage hierarchy. That is, a hierarchically inferior level of low-price (~ 1/3 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for temporary/unexpected (but critical) storage and/or for HSM-type low usage user data storage.

SATA drives external to the array are not new (nor are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array, with the firmware empowered to offer some SATA storage for low access customer data (as in FW-based HSM) and to retain some for critical short term and unpredictable storage needs that are not appropriate for cache/shared-memory or high price/performance storage (or for which there is no pre-allocated space). This concept is ideal to be used with several prior patent submissions:

- SBLMR - Safer Bitmap LUN Mirror Resync[docket #10011270]
- PLMVS - Primary Local Mirror Volume Shadow [docket #10020139D]
- SLM - Snapshot Liability Mitigation (not yet submitted)
- BWOP - Backup Window Overdraft Protection (not yet submitted)

In which extra storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array (as opposed to having to consider the unconventional use of hot spare disks). Specifically, the patent entitled 'Backup Window Overdraft Protection' (BWOP) in which a customer (that does not have licensed LUN copy or snapshot functionality, or does not currently have it set up for Zero Downtime Backup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the endangered backup using temporary non-volatile storage of sufficient capacity. The AHRS concept would be a significant competitive differentiator and potential lock-out spec.

Projects EVA V5.0

Products EVA future

Attachments

Attachments AHRS031103.doc - 3/11/03 12:06PM - ERS (Uploaded by Bob Cochran)

Description of Invention

Problems Solved See the attached ERS. Solves the problem of a disk array not having any non-

file: [redacted] 3/25/2003

volitile, uncommitted, unstructured storage for which the array firmware to solve temporary but critical issues.

Prior Solutions See the attached ERS. Prior arrays have only (relatively) expensive FC disk drives for non-volitile storage.

Not New:
- FC Disk arrays
- SATA Disk Drives
- Host SW controlled HSM (via external components)
- Intra-array LUN replication (e.g. snapshots and full copies)
- Inter-array LUN replication
- AutoRAID, disk array FW which moves data between RAID-1 and RAID-5 disk groups, depending on usage patterns (still all high-cost FC disks)
- Auto-LUN, host SW which moves files between RAID-1 and RAID-5 disk groups (and 10k rpm and 15k rpm), depending on usage patterns (still all high-cost FC disks)

Description See the attached ERS.
Firmware-based Hierarchical Storage Management (HSM) within a disk array utilizing both FC and SATA disk drives would be new. In this context, array FW could save the SATA storage as uncommitted/unstructured and only use it for:

- Low Usage files (tolerant of lower performance)
- Temporary (but critical), uncommitted, non-volatile storage that may or may not be pre-allocated into specific LUNs:
  - SBLMR - Safer Bitmap LUN Mirror Resync[10011270]
  - PLMVS - Primary Local Mirror Volume Shadow [10020136D]
  - SLM - Snapshot Liability Mitigation (not yet submitted)
  - BWDP - Backup Window Overdraft Protection (not yet submitted)
  - etc.
- Intra-array LUN snapshots
- Intra-array full LUN copies
- Inter-array LUN copies

NOTE: If this concept were an enabler for just a single related patent, I would have been tempted to combine the two. However, the fact that it equally enables at least 4 other patents, suggests that it should not become entangled/identified with any one of them.

Advantages See the attached ERS.
This concept is ideal to be used with several prior patent submissions.

- SBLMR - Safer Bitmap LUN Mirror Resync[docket #10011270]
- PLMVS - Primary Local Mirror Volume Shadow [docket #10020136D]
- SLM - Snapshot Liability Mitigation (not yet submitted)
- BWDP - Backup Window Overdraft Protection (not yet submitted)
- etc.

In which extra storage space (without the constraints of LUN copy boundaries, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array.

Invention History

Published No

Announced No

Disclosed No

Filed: [redacted] 3/25/2003

Next Three Months No

Described Yes - ERS entitled AHR3-ERS.

Built No

Government Contract No

Related Disclosure Yes - 10011270 - - SBUMR - Safer Bitmap LUN Mirror Resync[docket #10011270] - PLMVS - Primary Local Mirror Volume Shadow [docket #100201350] Both require temporary use of non-volatile disk array storage to solve a critical data integrity and/or replication issue. Also will be needed by: - SLM - Snapshot Liability Mitigation (not yet submitted) - BWOR – Backup Window Overdraft Protection (not yet submitted)

Innovation Workshop No

Inventor Information

Inventors	Bob Cochran 00014382	Hewlett-Packard Company Worldwide (5265-6588)	Roseville [redacted] United States [US]	
	Jeffrey D Ferreira-Pro 00358388	Hewlett-Packard Company Worldwide (5265-6675)	Roseville [redacted] United States [US]	

Witnesses

Witnesses	Marcel Dwelkot	Hewlett-Packard Company	5265-6588	Roseville	Worldwide (5265-6588)	[redacted]
	Timothy Lyons	Hewlett-Packard Company	5265-6588	Roseville	Worldwide (5265-6588)	[redacted]

Classification

Recommended Classification	ESG/NSS: Online Storage Division: Enterprise Storage
Keywords	EVA Internal HSM
Recommended Merlin Entity	OSDH

Recommended Merlin Responsible_attorney	Grant Rita	Hewlett-Packard Company	0000-1031	Ft. Collins	Worldwide (0000-1031)	[redacted]

Administrative Record

Date Submitted March 11, 2003 12:11PM

Legal Clerk	[redacted]	Hewlett-Packard Company	0000-1031	Ft. Collins	Worldwide (0000-1031)	[redacted]

PD Number 200311028

Date Received by Legal March 17, 2003

AHRS - ERS

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Rev. 1

External Reference Specification for:
AHRS – Array-based Hierarchal Rotational Storage

(To Accompany the Patent Disclosure by the same name. Intended to supply sufficient data that someone skilled in the art could use this ERS to implement a working model.)

Thumbnail Sketch: Traditional disk arrays have only 2 levels of hierarchical storage: (1) volatile solid state subsystem-based memory, and (2) high-reliability, high-performance, high-priced (2-5 cents/MB) SCSI/FC disks (traditional storage)

This patent describes a disk array architecture that is a hierarchically inferior level of low-priced (~ 1/3 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for non-performance/unexpected (rule of thumb) storage and/or for HSM-type low usage user data storage.

SATA drives external to the array are not new (not are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array, with the firmware empowered to utilize some SATA storage for low access customer data (as in FAB-based HSM) and to retain some for ad hoc short-term and unpredictable storage needs that are not appropriate for cache/fast-memory or high price/performance storage but for which there is no pre-allocated space. This concept is ideal to be used with several prior patent applications:

- SBLMR - Sally Bertani LUN Mirror Resync (docket # 10011270)
- PLMVS - Primary Local Mirror Volume Shadow (docket # 10020319-1)
- SLM - Snapshot Liability Mitigator (not yet submitted)
- BWOP - Backup Window Overdrive Program (not yet submitted)

in which either storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/partially needed within a disk array (as opposed to having to consider the unsurvivable use of hot spare disks). Specifically, the patent entitled "Backup Window Overdrive Program" (BWOP) in which a customer that does not have licensed LUN copy or snapshot functionality (or does not currently have it set up for Zero Downtime Backup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the unfinished backup using temporary non-volatile storage (if sufficient cache). The AHRS concept would be a significant improvement to functionality and potentially "look-and-feel".

Bob Cochran – HP Roseville, CA, NSS R&D Engineer/Scientist (Opus 43)
Jeff Ferreira-Pro – HP Roseville

Revision History

Rev.1 3-06-03, 3-11-03

High-Level Introduction

Traditional disk arrays have only 2 levels of hierarchical storage:

(1) solid state cache/shared-memory, and
(2) high-performance, high-priced (3-5 cents/MB) SCSI/FC disks (rotational storage).

This patent describes a disk array rotational storage hierarchy. That is, a hierarchically inferior level of low-price (~ 1/3 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for temporary/unexpected (but critical) storage and/or for HSM-type low usage user data storage.

SATA drives external to the array are not new (nor are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array, with the firmware empowered to offer some SATA storage for low access customer data (as in FW-based HSM) and to retain some for critical short term and unpredictable storage needs that are not appropriate for volatile cache/shared-memory or high price/performance non-volatile storage (or for which there is no pre-allocated space).

This concept is ideal to be used with several prior patent submissions in which extra storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array (as opposed to having to consider the unconventional use of hot spare disks). Specifically, the patent entitled 'Backup Window Overdraft Protection' (BWOP) in which a customer (that does not have licensed LUN copy or snapshot functionality, or does not currently have it set up for Zero Downtime Backup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the endangered backup using temporary non-volatile storage of sufficient capacity.

The AHRS concept would be a significant competitive differentiator and potential lock-out spec. Customers attracted to this feature would be in the mid and high-end range. This feature could result in solution configurations involving significant product/services drag to several parts of HP.

NOTE: If this concept were an enabler for just a single related patent, I would have been tempted to combine the two. However, the fact that it equally enables at least 4 other patents, suggests that it should not become entangled/identified with any one of them.

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- SATA Disk Drives
- Host SW controlled HSM (via external components)
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- Auto-LUN, host SW which moves files between RAID-1 and RAID-5 disk groups (and 10k rpm and 15k rpm), depending on usage patterns (still all high-cost FC disks)

What "is" new - The Proposed Improvements

Firmware-based Hierarchical Storage Management (HSM) within a disk array utilizing both FC and SATA disk drives would be new. In this context, array FW could save the SATA storage as uncommitted/unstructured and only use it for:

- Low Usage files (tolerant of lower performance)
- Temporary (but critical), uncommitted, non-volatile storage that may or may not be pre-allocated into specific LUNs:
  - SBLMR - Safer Bitmap LUN Mirror Resync[10011270]
  - PLMVS - Primary Local Mirror Volume Shadow [10020139]
  - SLM - Snapshot Liability Mitigation (not yet submitted)
  - BWOP – Backup Window Overdraft Protection (not yet submitted)
  - etc.
- Intra-array LUN snapshots
- Intra-array full LUN copies
- Inter-array LUN copies

This concept is ideal to be used with several prior patent submissions:

- SBLMR - Safer Bitmap LUN Mirror Resync[docket #10011270]
- PLMVS - Primary Local Mirror Volume Shadow [docket #10020139]
- SLM - Snapshot Liability Mitigation (not yet submitted)
- BWOP – Backup Window Overdraft Protection (not yet submitted)
- etc.

In which extra storage space (without the constraints of LUN copy licenses, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array.

HP-NSS R&D (Network Storage Solutions)

APPENDIX III

Ken Koestner

From: "SCHULZE,TARA (HP-FtCollins,ex1)" <tara.schulze@hp.com>
To: <kkoestner@kbpatents.com>
Sent: Monday, June 30, 2003 1:34 PM
Attach: 200311026.pdf; Supplemental Procedures for new cases.pdf; RFQ 200311026.doc
Subject: RFQ for New HP case=200311026

Ken,

Grant Ritz requested that I forward the above referenced disclosure to you for drafting.

Please find attached:

- RFQ and letter of engagement
- Disclosure 200311026
- Supplemental procedures for new cases

Please confirm receipt of this transmission via e-mail reply.

Thank you.

9/15/2006